

Developing a Community of Teachers through Integrated Science and Literacy Service-Learning Experiences

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Service-learning involves the integration of community service with academic coursework. Activities related to service-learning "... inform, clarify, illustrate and stimulate additional thought about academic topics covered in the classroom, as well as encourage students to develop or strengthen a habit of service and social responsibility to the community" (California State University, Fullerton, 2004, para. 1). There are numerous examples of service-learning reported in K-12 classrooms (e.g., Burns, 1998; Parsons, 1996; Stanton, Giles, & Cruz, 1999; Wade, 1997). However, it has only been during the past decade that there has been an increased interest in integrating service-learning activities with higher education courses (e.g., Erickson & Anderson, 1997; Eyler & Giles, 1999; Sax & Astin, 1997). Some teacher education programs have made an effort to include service-learning as an integral part of coursework (e.g., Donahue, 1999), but there are few studies addressing service-learning and science education.

Service-learning is particularly appropriate in elementary science methods courses because student teachers rarely get opportunities to teach inquiry-based science as part of their student teaching responsibilities. In the current standards-based climate, elementary teachers often

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focus on literacy and mathematics and do not always allot sufficient time for science or other content area teaching. In the area of reading and language arts, standards-based initiatives have had the unexpected effect of narrowing the school curriculum (Valencia & Villarreal, 2003). In California, for example, the reading/language arts framework recommends that students receive at least 2.5 hours of reading instruction daily in primary grades and at least 2 hours in the grades that follow (California State Board of Education, 1999). Add to that the time it takes students to practice for standardized tests, and there is often little time left to teach other subjects such as science. The integration of service-learning within an elementary science methods course can enhance preservice teachers' development of science content knowledge, pedagogical skills, and social understandings that will benefit their future students.

In this article we present a case study of preservice teachers engaged in service-learning in an after-school program while concurrently enrolled in science and language arts methods courses. Two interdisciplinary education faculty worked collaboratively to connect language arts and science methods content with service-learning experiences. Preservice teachers provided a service to elementary school students by developing and teaching integrated, inquiry-based lessons. The after-school program provided a service to preservice teachers by providing opportunities for them to interact with young children and teach integrated science and language arts lessons outside the constraints of a formal classroom setting. The preservice teachers' experience was considered "integrated" in this study because they were required to integrate language arts skills within every science lesson that they taught in the after-school program.

Service-Learning

The concept of service-learning as it is applied in teacher education programs varies widely, but it is generally designed to complement and extend field-based experiences already present in such programs. The service-learning assignment described in this study is most closely aligned with what Sigmon (1996) describes as "SERVICE-LEARNING" (as cited in Eyler & Giles, 1999, p. 5). The words are capitalized to symbolize the emphasis on both the service being provided *and* the learning that occurs as a result. From this perspective the purpose of engaging students in service-learning activities is similar to that of student teaching (i.e., to offer students the opportunity to connect theory with practice and practice their teaching skills). However, it differs from student teaching because service-learning assignments require students to provide a community service outside the formal classroom (e.g., after-

school programs, community service organizations), and addresses a real *need* for the students with whom they are working (Wade, 1997). Moreover, preservice teachers' roles in service-learning differ from their roles in the formal classroom because they are more likely to have decision-making authority regarding the service they provide, including the curriculum they teach and the methods they use (Erickson & Anderson, 1997). As a result, their potential for enhanced personal learning and professional growth is increased because they are directly responsible for determining the service needed.

The literature related to service-learning outcomes consistently states that allowing ample time for reflection is a critical component of success (Burns; 1998; Erickson & Anderson, 1997; Eyler & Giles, 1999; Gallego, 2001; Gray, Ondaatje, & Fricker, et al., 1999; Rhodes, 1997). Reflective discussion and writing allows students to monitor their own thinking processes as well as facilitate the connection between service and learning. However, the reflective process is not routinely built into most community service work, therefore reflection activities that connect theory and practice must be developed by faculty and embedded in the service-learning assignment (Eyler & Giles, 1999). Kaye (2004) discusses the importance of reflection but also delineates additional service-learning elements such as (a) integrated learning, (b) meeting community needs, (c) developing partnerships and shared responsibility, (d) choice and decision-making, (e) reciprocity of all participants, and (f) civic responsibility. Each of these elements was included within this study. The systematic examination of preservice teachers' critical reflections (as well as the elements specified by Kaye, 2004) can yield greater insight into learning, and help to develop guidelines for the successful use of service-learning in teacher education.

Context of the Study

In this case study, 32 preservice teachers in two different sections of science and language arts methods classes participated in an after-school program in five local elementary schools to fulfill cross-course requirements. Preservice teachers were enrolled in these two methods courses concurrently and participated in service-learning during the second semester of a two-semester, fifth-year teacher credential program. Therefore, this study is limited to one group of university education students. Erickson (1986) and Yin (1994) advocate that case studies provide depth, insight, and perspectives that are useful in various contexts.

Three specific course objectives were met by preservice teachers engaging in service learning. These included (a) recognizing the potential

of reading and the language arts to enhance science learning by integrating all aspects of the language arts (listening, speaking, reading, and writing) into science instruction (language arts course), (b) developing inquiry-based instructional skills required to encourage learning science concepts while enhancing students' skills and attitudes in science (science course), and (c) demonstrating an awareness of cultural, language, and socioeconomic issues and diverse instructional strategies (both courses). One of the purposes in assigning the service-learning experience was to determine if preservice teachers could develop an eight-lesson integrated science and literacy unit that would benefit the diverse students in the after-school program. A second purpose was to determine if the service-learning experience would help the preservice teachers develop the content knowledge, pedagogical skills, and social understandings in science that would benefit their future students beyond that of a regular student teaching experience.

Preservice teachers participated in service-learning for approximately 15 hours total (including an initial observation, planning, instruction, and assessment). They worked in teams of three or four to plan and implement eight integrated, inquiry-based lessons to elementary students who attended an after-school program at various school sites in a local school district. The teacher-student ratio ranged from 3:6 to 4:12. The students' level in each group ranged from 3rd to 6th grade. All of the students in the program were enrolled because of low academic skills or other factors that placed them at-risk for school failure. Nearly 100% of the students were from non-English language backgrounds. As in traditional student teaching and fieldwork, the preservice teachers engaged in many of the activities that are a part of classroom teaching. They set standards for behavior, developed and delivered integrated science lessons, assessed student progress, and interacted with other faculty and staff at the school site. However, there was no direct on-site supervision (i.e., master teacher) during the service-learning experience.

As university instructors, we believe that the main benefits of this service-learning project for preservice teachers included (a) participating in collaborative planning and teaching, (b) engaging in personal reflection, and (c) gaining confidence in teaching science content and literacy skills to elementary students, particularly those from non-English language backgrounds. Elementary students who required after-school care benefited from the project because they participated in a variety of language enrichment activities in small groups, enhanced their literacy skills, and increased their science content knowledge through interactive, inquiry-based activities.

Assessing Preservice Teachers' Knowledge and Skills

We required that preservice teachers submit a showcase portfolio at the end of the service-learning experience as the primary assessment measure. The portfolios were developed collaboratively by each team of preservice teachers. Each portfolio included: (a) a collaborative content organizer based on California State content standards; (b) eight collaborative lesson plans using inquiry-based models from Guillaume (2003); (c) each team member's reflection on the initial site visit; (d) each member's reflection on each lesson taught; (e) each member's self-assessment of their learning and performance; and (f) evidence of elementary student learning and interest, including written work, photographs and any other documentation that team members included to demonstrate elementary student outcomes and their teaching abilities.

We provided the preservice teachers with reflection prompts and asked them to respond to each topic at least once. These topics were organized to encourage a critical assessment of their experiences across a variety of issues related to both service learning and course content. The decision to require each topic to be addressed at least one time insured that there was enough flexibility for the preservice teachers to include their personal responses for each experience. The reflection prompts included:

- Describe contributions you made to the after-school program.
- Describe your interactions with students.
- How does this differ from your formal classroom teaching experience?
- Describe your understanding of student diversity and cultural awareness.
- How will this experience help your career as a teacher?
- Describe your application of learning theories, readings, and course content.
- Describe your understanding of students and how they learn language arts and science.
- What challenges did you encounter?
- Describe any personal gains you experienced by participating in a community service project.
- Describe how working with peers to plan and teach lessons helped or hindered your experience.

The reflections that the preservice teachers wrote after each lesson and in response to the self-assessment prompts were used as the primary data for analysis for this investigation. About 15% of the preservice teacher's grade was determined by his or her service-learning outcomes (based on the portfolio) for both the language arts methods class and the science methods class. Preservice teacher outcomes and analysis of data

were determined by matching their written reflections and lesson plans with course objectives. The instructor for the language arts class and the instructor for the science class evaluated the portfolios separately to determine if preservice teachers met the specific language arts or science course objectives. Open coding techniques were used (Strauss & Corbin, 1998) to further analyze preservice teachers' reflections to identify categories not included within the specified course outcomes and reflection prompts.

Findings and Conclusions

In addition to the specific course outcomes met by the service-learning experience, we found that teaching students in an after-school program particularly enhanced preservice teachers' (a) confidence to teach science and language arts, (b) ability to plan and implement collaborative lessons, and (c) self-worth as an educator because they provided a service to students and the community. These were identified as areas that preservice teachers do not usually get sufficient practice at developing during traditional student teaching experiences. To provide evidence for these findings, we have included representative samples of student written reflections from each of these areas to show the preservice teachers' "voice" and how service-learning impacted their self-confidence in teaching students and their professional development as a future teacher. The representative samples were consistent with lesson plans and student reflective comments across the data set as a whole. Data codes used for identification purposes are listed after each student quote based on their written reflections or lesson plans. Written reflections are identified by the group number, the code "wr," and the number of the reflection. Lesson plans are identified by the group number and the code "lp." All samples include a pseudonym identifying the preservice teacher.

Increased Confidence in Teaching Science and Language Arts

Eight different groups of preservice teachers focused on the teaching of integrated, inquiry-based science and language arts lessons for service-learning. Each group developed their lessons on a grade appropriate standard based topic area. For example, one group of preservice teachers organized their unit's lessons around the science topic outdoor habitats. They planned lessons that required elementary students to observe "mini-beasts" and other school yard creatures on the school playground (Group 1/lp/topaz). The elementary students made decorative posters to show these mini-beasts' unique characteristics, engaged in shared read-

ing activities that focused on the mini-beasts' structures and functions, and wrote and illustrated fact books about their behavior and interactions with their environment. Another group organized their lessons around the concepts of water and air. They included interactive activities to help students "better understand the importance of water and air to their bodies" and the environment (Group 4/lp/topaz). In addition, they planned inquiry lessons focusing on the effects of water and air pollution, creation of smog, and ways to reduce water and air pollution. The culminating project for this unit included letters to the principal suggesting ways that the school could reduce water and air pollution.

Analysis of each group's units and lesson plans led to the identification of three specific areas that contributed to how service-learning enhanced preservice teacher confidence in teaching science and language arts. These areas included: (a) the ability to plan inquiry-based interactive lessons using hands-on materials; (b) integrating the content area of science and language arts; and (c) teaching science to English language learners (ELL). Again, evidence to support this assertion is provided through excerpts taken from representative examples of student reflections and were consistent with comments found across the data set.

Inquiry based interactive science lessons. Preservice teachers included a variety of hands-on materials and realia within their inquiry lessons. They discussed how this was helpful for students attaining concepts and understanding the world around them. Specific examples included:

While we were teaching students we always include visual aids, that especially helps English language learners... there is a range of learners with a variety of needs. (Group1/wr3/maria)

I think the program gave me more needed experience teaching in a classroom setting and experience planning units and lessons. I also got practice using different lesson plan formats rather than direct instruction. (Group2/wr10/gina)

We allowed students time to observe the worms and write their observations. One of the things that I like about our curriculum is that we continue to draw on the skills we taught them about observing...having the actual creature there (worms) proved to be a great motivator. (Group3/wr5/sue)

The two activities that we had planned, the representation of stagnant air and the creation of smog soup were extremely effective at representing the concept of how contaminants cause smog under the right weather conditions. (Group4/wr6/don)

One group of preservice teachers planned lessons where elementary students became experts and inquired about scientific phenomena. Isabel

wrote that “The bulk of the lesson was having each of the four groups become experts with the habitat they were given. . . Each table was given a sentence strip with only the name of their habitat written in pencil on it. The group read books and looked at pictures to come up with what they wanted to add to the sentence strip” (Group 7/wr3/isabel). Another group included inquiry through sustained observation, “The students seemed like they could have spent the full 45 minutes observing the pillbugs. They let the bugs crawl all over their hands and arms. . . the exploration time enabled the students to create thorough descriptions of the bugs as well as the habitat in which they live in” (Group 1/wr4/cassie).

Analysis of student reflections across the data set shows that the service-learning assignment gave students the opportunity to not only plan but to implement inquiry-based science lessons. During their teaching experiences data show that students discovered the importance of using inquiry methods, such as providing hands on materials and activities that give students the opportunity to practice scientific processes and ask questions.

Integrating science and language arts. Preservice teachers integrated science and language arts in a variety of ways. For the most part, they engaged elementary students in writing about science and incorporated a variety of children’s literature within each lesson. For example, Sue discussed how informational science books and writing were integral parts of the lesson related to understanding science concepts. “One of the things that I really liked about this lesson is it really showed how you can incorporate language arts into science. Chris read them a wonderful informational science book and had them do some free writing as well. She had a lot of hands-on activities for them to do and they seemed to be very engaged the entire time” (Group 3/wr6/sue). Chris agreed that the use of literature helped students understand the function and structure of a cactus:

The last part of the lesson was dedicated to performing three activities to help students learn about the roots, pores, and waxy skin of a cactus and how each of the characteristics had a specific purpose for helping the cactus survive. . . I feel that the literature piece helped focus the students on the unique characteristics of cacti, and provided a good amount of background information for the students who may not have had experience with cacti. (Group 3/wr4/chris)

Other students discussed how they integrated student writing, “We put together *My Pillbug Book* where students recorded what they observed, their habitat, and any questions that may have about pillbugs” (Group 5/wr7/hallie). In another group one student wrote, “I have come to the simple conclusion that you cannot fully teach a subject without

integrating language arts. . . Using journals is a way to keep track of information learned and to incorporate writing." (Group6/wr3/leah).

Overall, preservice teachers indicated that they felt more confident in integrating the content area of science with the language arts. Jess stated that "A valuable lesson that I have learned is how to incorporate language arts in content areas, such as science. Through the service-learning project, we have incorporated language arts into our lessons in many different and creative ways" (Group3/wr10/jess).

Based on multiple reflections, students realized the benefits of integrating language arts into their science curriculum, thereby increasing the probability that they will continue to construct integrated lessons when teaching science in their own classrooms.

Teaching English language learners. Preservice teachers indicated that the knowledge that came from working with a small group of English language learners expanded their knowledge from their prior professional experiences and university coursework. Katie reflected on how service-learning helped her apply strategies for meeting the needs of English language learners:

I began by using one of the CLAD (Cross-Cultural Language and Academic Development) techniques called a pictorial input chart. . . The students had many questions as I spoke and I attempted to answer them and then I continued on with the drawing and the telling. . . First, I had to learn all of the information about insects and crickets that I could. Then I prepared my lesson regarding what I was going to say and draw. I had fun trying the technique. I am sure I'll use it again. (Group1/wr2/katie)

Sadie stated that service-learning helped her grow in her knowledge of effective strategies for English language learners. She wrote, "I am learning more and more how important it is to allow students, especially English language learners, to experience something first hand. Students need to see it as well as hear it as often as possible" (Group 6/wr4/sadie). After describing a lesson in which she provided support to a student who was having difficulty understanding the English directions, Beth noted, "When I begin to teach, this experience will help me teach other students like (him). I have learned to say a few more words in Spanish and I realize that providing hands-on experiences and visuals are essential for ELL students (when teaching science)" (Group 5/wr7/beth).

In their reflections, preservice teachers also discussed the value of structuring lessons so students who were having difficulty could receive support from their peers. Shelley described how students were divided into pairs to research and prepare a report on water pollution, "Grouping students into pairs was a good idea; I believe that it made the students who were not as confident in their language skills more confident" (Group

4/wr5/shelley). Ella also saw value in having students support each other. After describing how one student helped another by paraphrasing some of the information in Spanish, she remarked, "It was great to see the students working together... It seemed as though she was able to get as much out of the lesson as the English proficient students and I feel good about that" (Group7/wr3/ella).

Preservice teachers also emphasized how the informality of service-learning allowed them to use strategies with English language learners not widely used in the traditional classroom. One strategy that was often mentioned was using Spanish to support student learning. In California, all English language learners receive academic instruction in English unless their parents sign a waiver to permit them to be educated in a bilingual classroom, so this is a strategy that is used with relative infrequency in traditional classrooms. Preservice teachers, however, found it valuable in helping to overcome language barriers. For example, Sadie saw service-learning as an opportunity to communicate in Spanish:

When describing certain (types of) weather in English, I would try and describe it in Spanish as well. I feel that this was beneficial for both me and the students. It allowed the students to see that I was not afraid to try speaking Spanish and therefore it gave them more freedom to try English. (Group6/wr2/sadie)

The preservice teachers stated that these and other strategies they used helped them become more sensitive to diversity and to confront misconceptions they held about English language learners and at-risk students. They began to comment on the role language plays in learning. For example, Kathy described what happened when a student was having difficulty writing in English and was given the opportunity to write in Spanish: "This made her extremely comfortable and she ended up writing nearly a half a page poem about butterflies" (Group1/wr6/kathy). She also indicated that because students were given the opportunity to use the language they were most comfortable with, that the majority of the students were confident enough to share their poems with the class. In her final reflection she remarked, "I learned that each and every student is entitled to a quality educational experience—one that is meaningful to him or her. Students should not be ignored or neglected if they speak a language different than English" (Group1/wr10/kathy). Don made a similar point in his discussion about at-risk learners:

This experience has greatly changed my attitude toward these students, especially in the upper grades, labeled "at-risk" ... These are not slow students at all. They caught on to new concepts rapidly and were able to think like scientists and communicate effectively, even if they

sometimes struggled to find the correct words in English. (Group4/wr10/don)

The service-learning assignment gave students an opportunity to practice the teaching of science to a larger population of ELL students than they may have encountered in their student teaching classrooms. Overall, analysis of student comments show that they experienced firsthand the importance of incorporating multiple strategies for instructing students developing English as a second language, and how these strategies can impact student learning of science content.

Ability to Plan and Implement Collaborative Lessons

Preservice teachers viewed working with a team as being problematic in some cases. However, the majority of comments obtained through written reflections indicated that working within a small group to teach lessons was a positive learning experience. Two overarching themes were noted during analysis: support when planning lessons, teaching lessons, and locating resources; and the integration of multiple ideas and viewpoints during planning, implementing and evaluating lessons.

Some of the groups had difficulty in defining the role each one should play during a lesson. Casey described an incident where her team needed to make a decision about a lesson. She wrote, "This was a challenge because none of us wanted to step on the others' toes, so instead we avoided saying what was on our mind. It made me think about how it would be to team teach and also how it would be at grade level meetings" (Group8/wr6/casey). Leah stated that "In the beginning, it was difficult to figure out what we were going to do and what our overall goal was. Having four different people with their own ideas of what would be the best way to approach it was at first a little difficult" (Group6/wr4/leah). At the end of the same reflection Leah said that "We were able to find a way to organize both the lessons and instruction so that everyone's input was included. I think that now we all feel more comfortable expressing our concerns and make better decisions as a group." Like Casey and Leah, preservice teachers stated that while sometimes challenging, working as a team offered them opportunities to learn from and support one another. Kristy addressed the value of working within her group:

To begin, working as a team of teachers was interesting and always helpful. We planned, experimented, and instructed together, all along learning from one another. We all have different learning styles and I believe we were all effective. I liked that we could support each other during our instruction. (Group8/wr10/kristy)

Jess also stated that she had learned a great deal from working with her peers:

I have gained a lot from observing my fellow peers interact with the students and how they make a lesson come to life. Working as a team in this service-learning project gave me a glimpse of what it might look like once I become a teacher and need to plan with other teachers in my grade about a unit or ideas for lesson plans. It is a great opportunity to learn about teamwork and to receive both encouragement as well as constructive criticism. Teaching among peers has been a safe forum for learning how to teach and in trying new and different ideas. (Group3/wr10/jess)

Working together as a team resulted in collaborative professional experiences and preservice teachers discussing what they learned from each other. It was concluded through this analysis that the team teaching aspect of service-learning gave these future teachers skills that may be useful at their future school sites, as many schools use grade level planning and team teaching of content area subjects.

Developing Self-Worth

As part of the reflection prompts, we asked the preservice teachers to describe personal gains experienced through participating in service learning. Most of these comments related to preservice teachers' self-worth and the service they provided for students. For example, Ella concluded her self-assessment with, "I think it (service-learning) is a very valuable and wonderful thing to do for ourselves, our school, and our community" (Group7/wr10/ella). Jan concluded her self-assessment with a similar statement, "It also made me feel like I was doing something wonderful participating in a community service project" (Group8/wr10/jan). These comments were common within preservice teachers' reflections.

Additional comments related to the uniqueness of the service-learning program and their contributions to the community included:

The interaction with the students was wonderful. The after-school setting was much different than that of a typical classroom, and it allowed for more freedom, and less structure. The students did not feel nervous or apprehensive because the atmosphere was supportive, interactive, and very interesting. I believe that students need these types of opportunities to help build up their self-esteem, and to show them that learning science is important and gratifying. Watching the students engaged in the lessons, asking questions, and leaving with more knowledge than they came in with was very rewarding. (Group3/wr10/chris)

I feel that we not only contributed knowledge to the students, but hopefully, we also passed on encouragement to the students. Throughout our time with the students, we made an effort to build confidence in their learning abilities and encouraged them in their skills. Most importantly,

I feel that the students we worked with gained the sense that we believed in them and in turn, they began believing in themselves to accomplish anything they wanted to do. (Group3/wr8/jess)

Overall, the analysis of student comments in this area demonstrates pride in what they accomplished both as teachers and for their students. It is believed that these expressions of self-worth are directly connected to the fact that through this assignment it was their sole responsibility to plan and implement their lessons. Therefore, they had to attribute any feelings of accomplishment (as teachers, as class managers, as service-providers) to themselves and not to the skill or assistance of a master teacher helping them to be successful.

Discussion

Erickson and Anderson (1997) have suggested that one of the differences between service-learning and field-based experiences is that preservice teachers enjoy a sense of autonomy in service-learning compared to the more restrictive environment of the traditional classroom. In addition, preservice teachers perform a needed service for students in a context that is different from the elementary classroom where there is a trained teacher who is in charge of making instructional decisions. Data obtained and analyzed in this study shows support for service-learning in teacher education courses, particularly in science education, because elementary preservice teachers seldom have an opportunity to teach science. Furthermore, when they do teach science, they are not usually required to integrate science with the language arts, or use inquiry based instructional methods

The service-learning context placed preservice teachers in an environment in which they addressed the academic needs of English language learners. As university instructors, we required that their lessons integrate the language arts, and this created a need for students, many of whom had limited English skills, to read, write, speak, and listen to instruction in English. In order for the lessons to be successful, the preservice teachers needed to develop strategies that supported students in these areas. These findings support previous research that shows that the specific features of the service-learning experience help to influence participants' professional development (Eyler & Giles, 1999; Waterman, 1993).

We found that service-learning can make positive contributions to the professional development and, accordingly, to the confidence of preservice teachers. Based on the results of this study, we recommend that teacher education programs integrate service learning as part of

science instructional methods courses to provide a richer learning context for preservice teachers and extend opportunities to authentically use the content and skills presented in courses and traditional fieldwork assignments. In addition, the integration of science with language arts is recommended. The integration of these two subjects provides a realistic experience that preservice teachers can use to enhance student learning when they become classroom teachers.

Cumulatively, we found that service learning is a worthwhile instructional experience that helped preservice teachers feel more confident about teaching science and literacy and enhanced their knowledge and skills for teaching English learners. They learned to collaborate, share ideas, and teach together as they planned lessons as part of a team. They indicated through their reflections that working with diverse students was challenging but helpful as they begin their teaching career. Furthermore, they saw the work that they were doing in the after-school program as making a worthwhile contribution to the community. Methods courses that include a service-learning component have the potential to assist preservice teachers in connecting service-learning experiences with course content, build partnerships with area schools and families, and hone their teaching skills.

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